

A CHEMICALLY AND BIOLOGICALLY FUNCTIONALIZED DIAMOND SOLUTION GATE TFT AND ITS APPLICATION FOR DNA SENSING

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Abstract

Diamond has been proved as a stable material and can be functionalized with DNA and other bio-molecules via covalent bond, which is stable for long time, relative harsh treatment and high temperature. Recent studies have shown that diamond thin films can be used for the fabrication of biologically-sensitive field-effect transistors (Bio-FETs), in which the change in charge distribution associated with bio-molecular binding at a diamond surface induces a change in the diamond sub-surface depletion region. This type of direct Bio-FET sensing is important because it can be easily scaled down in size, leading to potential improvements in sensitivity and the creation of arrays of bio-FETs.

While fabrication of millimeter-sized FET's can be accomplished using simple procedures, to achieve highest sensitivity, built-in controls, and develop high-density arrays, it is necessary to use more advanced processing methods. It is particularly important to protect the electrical contacts from exposure to the physiological fluids. We have used lithographic processing methods to create small diamond FETs with channel lengths of 10 microns and have investigated how the electrical response is affected by the surface functionalization. We have compared 5 different types of surfaces, including H-terminated diamond, and diamond functionalized with molecular layers of Dodecene, TFAAD (chemically protected amine), deprotected TFAAD, and surfaces covalently linked to DNA. By characterizing the electrical response of diamond FET's modified with these different molecular layers, we gain insight into how to optimize the response for detection of chemical and biological molecules. Using this understanding, we have constructed diamond Bio-FET's functionalized with DNA and have investigated their electrical response. Our results demonstrate the ability to detect DNA hybridization and to distinguish between complementary vs. non-complementary sequences using a micron-scale diamond bio-FET.

REFERENCES

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